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OCT 27 1960
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DEPARTMENT OF COMMERCE AND INDUSTRIES

DIVISION OF FISHERIES
INVESTIGATIONAL REPORT No. 42

THE BIOLOGY OF GUANO-PRODUCING SEA-BIRDS

3. The Distribution, Abundance and Feeding Habits of the Cormorants *Phalacrocoracidae* off the South West Coast of the Cape Province.

BY

R. W. RAND

THE GOVERNMENT PRINTER, PRETORIA.
1960

G.P.-S.7273212—1960-61—1,200.

Reprint from "Commerce & Industry". APRIL, 1960

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Issued by the Division of Fisheries, Beach Road, Sea Point, Cape Town

Union of South Africa

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i. Summary.

1. During 1954–56 cormorants were hunted a few miles off the coast of the south-western part of the Cape Province as part of a study of their feeding habits.

2. Cape cormorants (204 specimens collected at sea during 1954–56) breeding in the late spring on several Cape guano islands, comprised an estimated population of 120,000 individuals off the Cape coast. They feed on a variety of small fish (dominated by sandeels and maasbankers), cephalopods, crustaceans and molluscs; the total weight of marine food consumed annually by this population is estimated to be 6,750 tons of which 34 per cent or 2,300 tons are fish of commercial value.

3. Bank cormorants (73 collected at sea during 1954–56) breed during the spring and comprise a population of about 3,000 individuals off the south-western coast of the Cape Province. They prey upon a variety of fish (principally clinids), crustaceans and cephalopods. An estimated 350 tons of marine animals are taken by the bank cormorants.

4. Only 11 White-breasted cormorants were collected during the pelagic investigation of 1954–56. These had eaten fish and crustaceans. About 1,000 individuals resort to small colonies off the south-western part of the Cape coast; they consume about 220 tons of marine food annually.

5. Crowned cormorants (only nine specimens were collected during this investigation) were rare, a population of about 500 adults residing on the Cape islands. They consume about eight tons of marine food annually.

2. Introduction.

This is the third of a series of reports by the present writer on the feeding habits of guano-producing sea-birds habitually found off the coast of the south-western Cape Province. It deals with the food and general habits of four species of cormorant that differ considerably in numbers and status off that coast.

Cormorants, other sea-birds and seals were regularly collected during pelagic cruises in 1954–56. The general technique and scope of this investigation have been described in previous reports (Rand, 1959, 1959a, 1960). Captured birds and the contents of their stomachs were handled in similar ways, namely, preservation of the whole stomach in the field until dissection and sorting of the contents in the laboratory. Notes on behaviour and associations were made at the time of capture. The small Cape cormorants were often difficult to hunt owing to the rapidity with which they dived, the small targets presented and the maintenance of a minimum escape distance in the face of pursuit. Crowned cormorants, rather diminutive birds as well, were only occasionally encountered near the shore. Bank and White-breasted cormorants, however, were less inclined to fly away but were relatively scarce everywhere.

The species usually seen at sea is the Cape cormorant which moves in large flocks across False Bay and off parts of the coast of the Cape Province, Natal and South West Africa. Very large numbers were claimed for this species during the last century and it was probably one of the most abundant of the sea-birds of our coast. Large congregations of the cormorants are less noticeable today and their erratic movements to and from the guano islands suggest that the population is not nearly as large as was once averred. In spite of this there are many who consider the Cape cormorant one of the most destructive predators of small fish. However, its role in the economy of the coastal platforms of South West Africa and of the guano islands farther south, make it an undoubted asset. The other cormorants are not ranked as important fish predators but they deserve far more attention as potential guano- producers.

3. The Cape Cormorant.

Because of its habit of hunting in flocks near the land, the Cape cormorant (*Phalacrocorax capensis*) has attracted public attention for many years. The species was first described in False Bay in 1788 and it is there that many flights of these birds were observed during subsequent years.

During pelagic investigations in 1954–56, 204 Cape cormorants were collected near the coast between Lambert's Bay and Dyer Island. Sixty-one (30 per cent) were immature birds. Males formed 61 per cent of all specimens that were sexed (see Table 1). Seventy-two (35 per cent) of the cormorants were shot between Table Bay and Saldanha Bay. Only 45 (22 per cent) were collected east of Cape Point (see Table 2).

(i) Bionomics.

The plumage is almost entirely black with, however, a noticeable bluish sheen in adult birds. Small white filoplumes appear on the neck of

those in breeding plumage. There is an orange naked strip (gape) at the base of the bill. The irides are blue.

Young birds have a brownish mottled appearance. The gular strip or gape is light yellow, iris blue. Some immature specimens acquired adult plumage in May. Much of the upper plumage is then black but the abdomen is still mottled. In other specimens the moult appeared to advance from below, the abdomen turning black while the head and neck retain traces of brown.

The length of the body is about 24 inches, the wing-span about 43 inches. Average standard dimensions (mm.) of males and females were respectively (the number of specimens is given in brackets): length 653 (8), 630 (2); culmen 55 (9), 56 (3); wing 267 (9), 258 (3); tail 101 (8), 90 (3); weight 47 oz. (24), 39 oz. (11). A large male weighed 60 ounces, the maximum weight recorded.

The arithmetical mean weight for both sexes was 45 oz., with a standard deviation of 5·9 oz. Immature cormorants had a mean weight of 41 oz. (S 4·7 oz.). *The mean weight of all specimens was* 1,204 *gm. or* 43 *oz.* (S 5·9 oz.).

The cyclic breeding of Cape cormorants is well-known (Sclater, 1906), nesting taking place on the guano islands during the spring and summer. Their arrival at old breeding stations is fairly regular but they may summarily desert their nests at any stage of breeding. The resulting widespread destruction of eggs and partly fledged chicks is perhaps one reason why the population is so unstable.

Nesting starts in August and may continue until February. Clutches of two or three eggs (maximum five) are incubated for 22 to 28 days (Priest, 1948). Nestlings are fledged as early as November and reports from some Cape guano islands suggest egg-laying may be repeated before the previous brood has left the nesting place.

There is no information about the frequency of feeding journeys but the movements of flocks indicate that journeys of at least several hours must take place. They are interrupted by roosting at sea or on coastal rocks. The significance of overnight roosting away from the nests is worthy of further investigation.

Observations showed that some specimens had moulted in July or August; immature ones underwent their second winter moult in these months as well. Breeding adults showed a post-nuptial (?) moult in November and December. Young birds in their first winter plumage moulted from April to July, although some replaced their feathers in December and January. The moult is gradual and hardly affects the movements of the birds. The bedraggled appearance of some young birds suggests, however, that water-logging and some impairment of flying through loss of feathers from the wing and tail does occur.

(ii) Distribution.

Cape cormorants have been reported from Majoumba and Landana near the River Congo but are more often seen along the southern part of the African coast between Cape Cross and Table Bay, and thence esatwards to Durban. They extend about thirty miles out to sea but usually remain near the land.

Cormorants of the south-western Cape coast, breeding from Lambert's Bay to Dyer Island, have an estimated feeding range of 4,000 square miles.

(*a*) Migration.

Anderson (1872) stated that Cape cormorants leave Walvis Bay in December, returning there again in June and July. Pym (1909) noted that they were common in East London during the winter. The arrival of breeding cormorants at the southern guano islands is a distinctly seasonal one and governs the traditional policy of closing the islands to visitors in September.

The tempo and direction of the migratory wave is not at all clear but migrants appear to be adults mostly, with relatively few immature birds. Ringed young cormorants from Saldanha Bay have nevertheless been recovered at Luderitz. Others have been sighted at Durban. Some young birds do not leave the vicinity of the Cape Peninsula at all. Not only were they included in the pelagic collections (see Table 1) but are believed to be the chief age-class encountered in St. Helena Bay during the winter (cf. census reported by Davies, 1956).

The intensity of the migratory wave can be studied conveniently at the West coast islands, many of which fall directly in the path of the migrants. In 1948 flights of Cape cormorants passed Sinclair Island during January and February; 19,074 of these birds were counted as they

passed northward in the late afternoons. Some migrants moved against the general direction of migration and movement appeared to cease when fog obliterated the outline of the coast.

(*b*) Sight Records: R.S. "*Africana II*", 1950–53.

Cdr. Thomas (*in MS.*) found Cape cormorants thirty miles from the nearest land. They were encountered in the Lambert's Bay-Saldanha Bay investigational area during most of the year.

(*c*) Sight Records: Pelagic Investigations, 1954-56.

During 1956 flocks of Cape cormorants were seen in various bays and coves throughout all search areas. Especially big groups were seen throughout the year in Table Bay where they preyed upon juvenile fish. They were common on the Bredasdorp coast (Quoin Point to Cape Agulhas) during December.

(*d*) Platform Population.

Cape cormorants have nested for several years on man-made platforms constructed in the sea near Walvis Bay and in a shallow lagoon near Cape Cross. Eggs and chicks may be seen on these platforms during many months of the year. The cormorant population, artificially sustained and protected at the platforms, is of great importance to that aestivating on the Cape Islands owing to an alleged exchange of individuals. The nature of the connection, however, is by no means clear.

(iii) Abundance.

In the past, flights of Cape cormorants have attracted much attention. Woodward (1899) mentions that " occasionally the birds visit the Natal Bay. One season we remember it was quite black with them ". Sclater (1906) notes how " they fly to their fishing grounds in a long line, sometimes in small parties of 3 or 4, sometimes in enormous flocks, which must often contain millions of birds ". (This latter statement is an exaggeration, for if it could be maintained in flight, a V-formation of a million cormorants would reach over 200 miles. Nevertheless concentrations of feeding birds may give a superficial impression of very large numbers.)

(*a*) Island Populations.

Cape cormorants of the south-western coast of the Cape Province normally breed only at Lambert's Bay Island, Malagas, Marcus, Jutten, Dassen, Dyer, and Vondelings with minor flocks at Schaapen and Meeuw islands. They roost on rocks and islands such as Paternoster, Jacobs Reef, Duikerklip, Seal Island (False Bay) and elsewhere close to the shore. Counts of nesting pairs on the large islands give a good estimate of the size of the population.

Preliminary counts from photographs of an aerial reconnaissance of all islands on the 23rd November, 1956, revealed that the Cape cormorant population was of the following order: Lambert's Bay 31,000; Jutten 28,200 and Vondelings Island 800. Other nesting places were deserted when the photographs were taken. About 60,000 Cape cormorants were, therefore, counted on Cape islands during 1956. If all these birds were each occupying a nest singly, then the count represents a total population of about 120,000.

(*b*) Numbers in the Bird Log, 1950-53.

Visits to routine stations A to T accounted for 4,829 Cape cormorants during 21 months in 1951–53 (Thomas, *in MS.*). Most of these birds came from stations P and M (four and three miles from land, respectively) during August and September. Large numbers were also recorded north of St. Helena Bay at stations X 19 (near the Groen River) during September, 1951.

(*c*) Numbers from Pelagic Studies, 1956.

Efforts were made to count Cape cormorants on all occasions during cruises in 1956. The flocks recorded were of various sizes, but, except in Saldanha Bay, rarely exceeded 50 or 100 individuals. Thirty-two flocks were recorded during this year, the largest number (6) being seen in October. The greatest number of solitary individuals (66) was recorded in that month. More than two flocks were seldom seen during a day's cruise.

(*d*) Numbers in St. Helena Bay, 1953–55.

In reporting weekly counts of Cape cormorants flying northwards past Shell Bay Point in the morning, Davies (1956) found the highest numbers in the winter (41,113). All these birds were assumed to fish in St. Helena Bay, but would rather appear to be a fair measure of density off the whole south-west Cape coast.

(iv) General Account of Food.

A contention by Anderson (1872) that this species " feeds on fish and sometimes mussels " was elaborated by Sclater (1906) who added " other marine animals ". A young cormorant (body weight 1,113 gm.) shot on Seal Island (False Bay) during October, 1950, had eaten two maasbankers weighing 60 gm. (Rand, personal observations). Davies (1954) reported vlei sardines (*Atherina*

breviceps) in cormorant stomachs from St. Helena Bay and Saldanha Bay. He later (1955, 1956) listed six fish and crustaceans as prey in these localities: Pilchards (*Sardinops ocellata*), Maasbankers (*Trachurus trachurus*), Anchovies (*Engraulis japonicus*), *Paralepis* sp., Rockfish (*Clinus*), Hottentot-fish (*Pachymetopon blochii*), Shrimps (*Palaemon pacificus*), and Cape rock lobsters (*Jasus lalandii*).

During the pelagic investigations of 1954–56, this list of prey was supplemented by the following: Mackerel (*Scomber japonicus*), Sandeels (*Ammodytes capensis*), Round Herrings (*Etrumeus micropus*), Windtoys (*Pterosmaris axillaris*), Sandcords (*Gonorhynchus gonorhynchus*), Gobies (*Gobius nudiceps*), Blennies (*Blennius cornutus*), Butterfish (*Palunolepis brachydactylus*), " Sardinhas " (*Sardinella aurita*), Mullets (*Liza ramada*), Steenvis (*Chilodactylus fasciatus*), Gurnards (*Trigla capensis*), Needlefish (*Hemirhamphis far*), Trumpetfish (*Macrorhamphis gracilis*), various crustaceans, cephalopods and molluscs.

In June, 1957, cormorants (presumed to be *P. capensis*) collected on a coastal lake in the George district by the Divisional Council, had eaten vlei sardines (*A. breviceps*) dragonfly larvae and a pipefish (*Syngnathus*).

(*a*) Weight of Food in the Stomachs.

A mean weight of 51·6 *gm.* (*S* 53·6 *gm.*) *or two ounces of food was found in* 204 *stomachs of Cape cormorants collected at sea during* 1954–56. The greatest weight of food in any stomach was 309 gm. from an adult male captured in Table Bay during December. The amount of food in Cape cormorant stomachs during various months is given in Table 3. The highest monthly mean (89·8 gm.) came from November.

The arithmetical mean weight of food in the stomachs of 22 cormorants shot during the morning at Langvlei (George district) was 18·1 gm. (S 8·7 gm.) or just over half and ounce. The greatest weight of food was 41 gm.

(*b*) Size of Prey.

The largest fish recorded in any stomach was a pilchard of length 28 cm. taken in St. Helena Bay during August. Other large prey were also pilchards of slightly smaller size (20–25 cm.), Sandeels 20 cm., clinids up to 15 cm., and a hottentot-fish 15 cm. long.

(*c*) Composition by Numbers.

Sandeels, the most numerous prey, were followed by windtoys, maasbankers, pilchards and anchovies. Megalopa larvae were the dominant crustacean prey (see Table 4).

According to their numerical status, fish were 91 per cent of all other organisms, crustaceans 8 per cent and cephalopods less than one per cent. The numbers of the more important prey-organisms were as follows (numbers of individual species as per cent of total numbers are given in brackets): Sandeels 457 (22 per cent), windtoys 373 (18 per cent), maasbankers 336 (16 per cent), pilchards 304 (14 per cent), anchovies 250 (12 per cent), crustaceans 189 (9 per cent) and cephalopods 3 (1 per cent).

(*d*) Composition by Weight.

Fish constituted the bulk (94 per cent by weight) of the food. Crustaceans and cephalopods were low in weight although the former prey reached an appreciable volume in some stomachs (see Table 6).

Sandeels (24 per cent) were the principal fish-prey but were closely followed by maasbankers (22 per cent), anchovies (14 per cent) and pilchards (12 per cent). Crustaceans were less than 6 per cent of the weight of all food. Stones and mollusc shells, when present, weighed only a few grammes. Seasonal variation in the weight of prey is shown in Table 6.

(*e*) Composition by Frequency of Occurrence.

Fish were found in 168 (82 per cent) of the stomachs (see Table 5); maasbankers occurred in 46 (23 per cent), anchovies and sandeels in 32 (15 per cent), pilchards in 18 (9 per cent) and other fish in relatively few stomachs. Cephalopods were recorded from only three (2 per cent) stomachs but crustaceans from 55 (27 per cent). Seasonal variation in the take of prey is shown in Table 5.

On the basis of frequency of occurrence, the prey was associated in the following way:—

59 per cent fish: 39 per cent crustacean: 2 per cent cephalopod.

(*f*) Regurgitations.

Traces of food organisms were not critically studied in the occasional regurgitations noted among old Cape cormorant nests.

(v) Individual Food Items.

At least 18 different species of fish were recorded from Cape cormorants collected at sea during 1954–56. Two of these (pilchards and maasbankers) are of major economic importance.

(*a*) **Maasbanker** (*Trachurus trachurus*).

Maasbankers in 46 (23 per cent) of the stomachs were a dominant prey on the frequency basis for nine months of the year (they were not recorded from June until August). They were the third most numerous fish, exceeded only by sandeels and windtoys.

About 336 maasbankers were counted in these stomachs, i.e. a mean of 7·4 per stomach. Fifty-nine appeared in one stomach in November. Eighty-nine per cent or 266 maasbankers were under 10 cm. in length. No maasbankers were over 15 cm. long.

Maasbankers formed 22 per cent by weight of all fish and were exceeded only by sandeels (24 per cent). They were combined with all other prey but were taken alone on 18 occasions. They appeared in stomachs collected throughout the day over a temperature range of 10·9° C to 17·2° C. Stomachs with maasbankers came from all areas, but most were from the vicinity of the Cape Peninsula.

(*b*) **Sandeel** (*Ammodytes capensis*).

Sandeels in 32 stomachs (15 per cent) were second in importance on a frequency basis. At least 457 individuals were counted in these stomachs, a mean of 16 per stomach. Fifty juvenile fish of length about 5 cm. were counted in one stomach examined during December. Numerically the sandeels were an important prey and by weight (24 per cent) they dominated all other forms.

Sandeels reached a length of 20 cm. in a stomach collected during November. They were preyed upon in all search areas near the Cape Peninsula during all months except February, April and July (they were caught when spawning in False Bay in early October). They were hardly ever combined with other prey-organisms (see Table 7).

(*c*) **Anchovy** (*Engraulis capensis*).

Anchovies in 32 stomachs (15 per cent) were important prey; over 250 individuals were counted in these stomachs, a mean of at least 8 fish. The bulk of anchovies were caught in the spring (September, October and November). They comprised 14 per cent by weight of all the fish prey.

The largest achovy was 12 cm. long, others being under 10 cm. The highest number in a stomach was 20 (each about 9 cm. long). Anchovies were caught in most areas throughout the day over a temperature range of 15·3° C to 17·2° C.

(*d*) **Pilchard** (*Sardinops ocellata*).

Pilchards were recorded in 18 stomachs (9 per cent) from the winter and spring (July to December) rather than from other months. They weighed 12 per cent of all fish food and were numerically fairly important (see Table 4). Unlike other prey, large pilchards over 15 cm. long appeared singly in several stomachs, but there were 60 juvenile pilchards about 5 cm. long in one stomach.

Of 97 pilchards that could be accurately measured, 89 per cent were under 5 cm. long. The fish were taken at all times of the day over a temperature range of 13·2° C to 17·2° C.

(e) **Windtoy** (*Pterosmaris axillaris*).

Windtoys were recovered from 10 stomachs (5 per cent), which contained 373 of these fish (a mean of about 41 per stomach) weighing 657 gm. or a mean of about 2 gm. each. They were 6 per cent by weight of all fish (see Table 6).

Cormorants preyed upon large numbers of this fish off the Cape Peninsula: one stomach contained 105 with a total weight of 145 gm. They were taken with other fish and crustaceans. They were especially common in stomachs collected off Llandudno (near Hout Bay).

(*f*) **Round Herring** (*Etrumeus micropus*).

Nine stomachs (4 per cent) contained round herrings with a total weight of 442 gm. (4 per cent of the weight of all fish). Sixty-two fish were found in these stomachs, a mean of about seven per stomach.

Only juvenile stages appeared (as many as 60, each about 4 cm. long, were in one stomach), and were taken at all times of the day over a temperature range of 13·7° C to 17·2° C. None measured more than 7 cm. long. The fish were an autumnal or early summer prey off the West coast

(*g*) **Sandcord** (*Gonorhynchus gonorhynchus*).

Sandcords in eight stomachs (4 per cent) weighed 103 gm. or 1 per cent of all fish prey. Over 38 sandcords were counted. Thirty juvenile fish, about 2 cm. long, appeared in one stomach (April). The Cape cormorants preyed upon these fish in the autumn and spring rather than at other times. They were captured in St. Helena Bay and off the Cape Peninsula.

(*h*) **Mackerel** (*Scomber japonicus*).

Twenty-one mackerel from four stomachs weighed 127 gm. They were of minor importance.

All fish that could be measured accurately were about 5 cm. long and had been taken in January, May and November from the False Bay–Table Bay area throughout the day.

(*i*) **Hottentot-fish** (*Pachymetopon blochii*).

Four hottentot-fish came from two stomachs collected off Cape Point (April) and Robben Island (September) during the afternoon. The fish were associated with squid, crabs, isopods, clinids, sandcords and small maasbankers.

(*j*) **Rockfish.**

Three gobies (*Gobius nudiceps*) were captured by an adult cormorant fishing near Roman Rock (False Bay) during August. They were taken there again in October.

Twenty blennies (*Blennius cornutus*) were found in a stomach from Robbesteen during September. Five others were taken in November from Stompneus.

Unidentified clinids (*Clinus*) were found in six stomachs from the Cape Peninsula and Robben Island. Eight fish weighing 100 gm. were counted in one stomach obtained in the afternoon.

(*k*) **Miscellaneous Fish.**

Unidentified fish occurring in 46 stomachs, weighed 13 per cent of all fish. It is believed that most of them belonged to the species listed in this report. Seven species occurred in single stomachs, particulars of their capture being given in Tables 4 to 6 and also as follows:—

Species.	Number.	Place.	Month.
Butterfish	3	Cape Point	October.
Steenvis	1	Table Bay	September.
"Sardinhas"	several	St. Helena Bay	November.
Mullet	1	False Bay	August.
Gurnard	15	Table Bay	September.
Needlefish	several	St. Helena Bay	November.
Trumpetfish	1	Table Bay	September.

(*l*) **Crustaceans.**

Crustaceans were found in 55 stomachs (27 per cent). Their weight was insignificant but they occasionally reached a high volume. It might well be that they have a roughage value of importance to the cormorants.

Isopods (in 15 stomachs) were collected by the cormorants throughout the year close to the shore in Buffels Bay, Sand Bay and Table Bay. Most isopods were parasitic forms such as *Codonophilus imbricata*, *Lanocira capensis*, *Anilocra capensis* and *Pontogeloides latipes*, and were found with fish prey such as *Pachymetopon*, *Pterosmaris* and *Ammodytes*. It is not known if these three latter species were hosts to the crustaceans whose exoskeletons resist digestion making it difficult to tell how long they had been associated with the other prey. Eleven *Lanocira* and five *Anilocra* were found in two stomachs under circumstances suggesting that they had been deliberately taken by the cormorants. Other isopods occurred singly or in pairs.

Amphipods in five cormorant stomachs, had apparently all come from the stomachs of fish prey (clinids or pilchards). *Hyperia* was identified in a stomach from December.

Large pink juvenile stomatopods (*Squilla*) in 11 stomachs had been deliberately hunted by the cormorants during late spring and autumn, coming mostly from Table Bay in May.

Mysids in two stomachs (October) had apparently come from captured anchovies.

A few euphausiids were taken in Table Bay during May.

Juvenile decapods were the most important crustacean prey. Thus traces of a crab, *Porcellana streptocheles*, were found in three stomachs from Cape Point during April, August and October. Juvenile rock lobster (*Jasus lalandii*) appeared in four stomachs from Table Bay and Robbesteen (October and December). One stomach with nine larval rock lobsters and another with three, suggested that the cormorants had actively hunted this prey. Megalopa larvae (*Plagusia*) were taken from July to January and again in April, the bulk coming from September and October. One cormorant captured 25 megalopa in Table Bay, another took 14 in False Bay. Peneid shrimps were recorded from five stomachs (see Table 5).

Parasitic copepods (*Caligus* and juvenile *Cymothea*) were found in three stomachs.

Traces of crustaceans in a stomach from Robben Island were not identified.

(*m*) Cephalopods.

Only two stomachs held traces of cephalopods; a small cuttlefish from False Bay (October) and two squids from Cape Point (April).

(*n*) Other Molluscs.

Nine stomachs contained pieces of shell or whole molluscs such as juvenile *Mytilus*, *Ostrea*, *Patella*, *Nassa*, *Murex*, *Tricolia* and *Gibbula* combined with a variety of fish and crustaceans. They were associated with stones in only one stomach.

The contention that cormorants feed on mussels was not taken seriously until an examination of the stomach showed that mussels are not only ingested but in the case of larval forms may have food value of some significance.

(*o*) Miscellaneous.

Feathers, sea-weed, hydroids and green mucus were frequently seen in partly-filled or nearly-empty stomachs. Nematodes (*Contracaecum*) were recorded from most stomachs. Only one feather was found and it does not suggest any special role such as the food plug in the stomachs of grebes (Madsen, 1957).

(vi) Feeding Habits.

When hunting, solitary cormorants stay submerged for about 30 seconds, pursuing fish by paddling with their webbed feet. The diving behaviour of a young Cape cormorant fishing near the naval jetty at Saldanha Bay was: submerged 14 seconds, at surface 3 seconds, submerged 33 seconds, surfaced 10 seconds, submerged 25 seconds, at surface 10 seconds, until finally lost to sight. The tempo of diving and surfacing hardly varies even if small fish only are caught. The cormorants either rest on the surface or fly away to land roosts after capturing sufficient prey.

Flock feeding is difficult to evaluate owing to the confusion of large numbers of birds in constant movement. No organised activities have been noticed, the flock swooping on a shoal, individual cormorants diving and surfacing repeatedly. As the prey moves, so the flock pursues it, settling to dive continually in a series of leapfrogging movements.

Social hunting is not the only pattern of feeding but it is the most spectacular and probably a common method of seeking food when this is abundant. Solitary cormorants frequently feed unobtrusively in bays or harbours in spite of others hunting in large flocks nearby. Flocks of the cormorants radiate from the nesting colonies in the early morning, sweeping along the coast until they locate food.

There is a return movement during the afternoon unless (as in the case of immature birds) they decide to roost overnight in sheltered bays such as Simon's Bay (False Bay). The search for shelter may involve a considerable amount of flying. Flocks of young cormorants often wheel into Table Bay, and if disturbed there, return round the coast towards Hout Bay. Older birds during the breeding season endeavour to reach an island and commence their return journey early in the afternoon.

Feeding appears to be fortuitous but when calculating the total weight of food taken at specific hours of the day (see Table 9), three peaks of feeding are noticeable, namely, at 1000–1100, 1300–1400 and 1700–1800 SAST.

The correlation between abundance of food and cormorant movement is by no means clear. It is often difficult to credit such a swift-flying predator as the Cape cormorant with nest desertion due to an alleged scarcity of fish in the vicinity of the islands. Such allegations are worthy of further investigation.

(vii) Consumption of Food.

Debris from previous meals had disappeared from almost all stomachs collected during 1954–56. In 53 stomachs with contents weighing more than 50 gm., only two stomachs contained bones and debris, while eight had a few otoliths from the penultimate meal. Other stomachs contained prey that could clearly be associated with the last meal. As the specimens were collected at random, many meals were obviously incomplete but those birds with stomach contents of over 50 gm. had usually digested a substantial portion of a recent meal. The maximum amount was 309 gm., but most specimens had considerably less than this. From inspection of the heavier stomachs, *the mean weight of food taken at a meal was* 104 *gm.* (see Table 10).

There is considerable doubt about the number of meals taken daily. Previous experiments on the rate of digestion of captive birds showed that 89 per cent of the stomach contents disappear in two hours (Davies, 1956), and it was estimated that two complete feeding cycles (meals?) were possible over a ten-hour hunting day.

Avila (1954) gave caged cormorants (*P. bougainvilli*) about 359 gm. daily or about 17 per cent of the body weight. On this basis Cape cormorants would need about 205 gm. daily (maximum 285 gm.). This corresponds to two meals a day although the observed maximum of 309 gm. would imply a sufficiency in one heavy meal. Examination of stomachs of Cape cormorants captured at sea during 1954–56 showed that the contents are entirely evacuated before further feeding and in only a few cases had second meals been taken during the same day. Nevertheless, the hourly food consumption suggested a two-meal daily cycle with an occasional third meal.

The average amount of food in 204 stomachs of Cape cormorants was 51·6 gm. (S 53·6 gm.). According to Simpson and Roe (1938) six times the standard deviation will give the range of such a sample. It is unlikely, therefore, that the weight of food per day would exceed 321·6 gm. It appears then that two meals daily, each of a mean weight of 104 gm., is not an unreasonable assessment of the mean daily consumption. For purposes of computation, however, the daily consumption will be taken as lying near the statistical maximum (321 gm.) and the figure for two average meals (208 gm.), namely about 280 gm. or ten ounces.

If 120,000 Cape cormorants each eat ten ounces of food daily, the consumption off the south-west Cape during the calendar year would be about—

$$\frac{120{,}000 \times 10 \times 180}{2{,}000 \times 16} = 6{,}750 \text{ tons.}$$

This figure of an annual consumption of marine foods is probably a high one as it does not consider the effect of non-fishing days and other factors detracting from continual feeding. The exodus of the birds from the Cape is given here as complete but it must be remembered that young birds may be found in the area during some winter months.

4. The Bank Cormorant.

Bank cormorants (*Phalacrocorax neglecta*) are large black birds frequently seen among inshore kelp beds round the Cape Peninsula. Although not considered of great importance to the guano industry, sizeable colonies do occur on some islands such as Dyer, where they contribute quite substantially to the guano crop.

Seventy-three bank cormorants were collected during 1954–56, almost all from the vicinity of the Cape Peninsula (see Table 11). They were rarely encountered on the normal search routes but could always be obtained in certain coves such as Sand Bay, or close inshore near kelp.

(i) Bionomics.

Although the cormorants are wholly black, adults may acquire small white filoplumes on the rump and sides of the neck during the breeding season (some authors use the name " Speckled-back cormorant " on this account). Standard dimensions (mm.) of specimens caught at sea were: length of males 725 (6), females 690 (3); wing 294 (12), 278 (3); tail 123 (12), 118 (3); and culmen 59 (13), 58 (6).

The arithmetical mean weight of 21 male bank cormorants was 4 lb. 6 oz. (S 4·9 oz.) and of 14 females 3 lb. 12 oz. (S 4 oz.). The maximum weights were 77 oz. (males) and 70 oz. (females); *the mean weight of all specimens was* 66·7 *oz. or* 1,867 *gm.*

Bank cormorants were thought to nest from May till July laying a clutch of 2 to 3 eggs that are incubated for three or four weeks (Priest, 1948). Bentham (1929) found eggs in June and December. There is undoubtedly much variation in the breeding season. From monthly observations at Malagas Island during 1956/57, the bank cormorants produce eggs in September (August at other islands), young being fledged by December and January. From then until May, adult Bank cormorants disperse from their old nesting places returning there only during inclement weather. Sporadic nest-making occurs as early as April but it is not until July that large nests are constructed. Heavy rains and high seas during the winter may inundate the colonies and so force the birds to undergo a more protracted nesting season.

Frequent feeding journeys are performed when nesting starts, but as the colonies are situated near the feeding grounds, the cormorants seldom absent themselves for more than a few hours.

The moult is gradual and hardly interferes with the movements of the cormorants. From specimens collected as sea, many birds moulted in the autumn (March to May) but feather replacement takes place at other times as well.

(ii) Distribution and Abundance.

Bank cormorants were originally described in 1865 from islands near Luderitz. Large flocks reside on the northern guano islands of Ichabo, Mercury and Possession but it is not certain if they breed much further north [cf. Rand (1952) suggested they nested on the platforms at Walvis Bay and Cape Cross]. They extend eastwards at least as far as Durban.

During the pelagic studies of 1954–56, Bank cormorants were sighted in bays and along the coast in close association with kelp and underwater reefs.

Thomas (*in MS.*) recorded the cormorants at least 76 miles from the nearest land. They appeared at the West Coast research stations from January till April, but only rarely. Thomas notes that they are not usually seen more than six miles from the shore and pelagic investigations support this dispersal. An immature Bank cormorant, sighted 58 miles west of Cape Columbine during March, 1951, suggested a wider dispersal for young cormorants.

(*a*) Island Populations.

The cormorants nest on all islands and many rocks off the Cape coast. The larger colonies exist at Malagas, Jutten, Dassen en Dyer Islands but others may be seen on rocks at Clifton, Smitswinkel Bay, Hermanus and elsewhere along the Bredasdorp coast.

During November, 1956, an aerial photographic reconnaissance revealed the following numbers of nests on various islands falling within the area of the present investigation: Quoin Rock 22, Geyser Rock 36, Dyer Island 30, Duikerklip 62, Dassen Island 35, Jacob's Reef 3, Vondelings Island 29, Marcus Island 43, Malagas Island 102, and Jutten Island 35. This count does not fully represent the nesting population which would be slightly higher during preceding months. The island population is, therefore, estimated at about 1,000 individuals; such numbers would be greatly enhanced by those nesting on coastal rocks not included in the aerial survey. It is believed, however, that the total population of Bank cormorants of the south-western Cape coast is not more than about 3,000 individuals.

(iii) General Account of the Food.

Sclater (1906) noted how the Bank cormorant feeds " chiefly on crayfish (*Palinurus*) and Hottentot-fish (*Centharus blochii*) which are found about parts of the sea-bottom where there are rocks overgrown with sea-weed; and by watching the places to which the Bank-duikers resort for fishing in the early morning, fishermen are able to discover the best fishing banks. It is from this fact that the Bank-duiker derives its name." Davies (1955) found that the species showed a preference for rocky inlets and bays, feeding on klip-fish (Clinidae) and young Cape rock lobsters (*Jasus lalandii*).

During the investigation of 1954–56, Bank cormorants were proved to have preyed upon the following species:—

Clinids (Clinidae); Blennies (Blennidae); Rockfish (*Gilias capensis*); Gobies (Gobidae); Steenvis (*Chilodactylus fasciatus*); Suckerfish (*Chorisochismus dentex*); Panga (*Pterogymnus laniarius*); John Brown (*Gymnocrotaphus curvidens*); Rockling (*Gaidropsaurus capensis*); Windtoy (*Pterosmaris axillaris*); Sandeel (*Ammodytes capensis*); Sandcord (*Gonorhynchus gonorhynchus*); Pipefish (*Syngnathus fasciatus*); Anchovy (*Engraulis capensis*); Gurnards (Triglidae); Frogfish (*Batrichthys felinus*); Eel (*Conger conger*); Sole (*Heteromycteris capensis*); Flounders (Bothidae); various crustaceans; cephalopods; other molluscs and enchinoderms.

(*a*) Weight of Food in the Stomachs.

The maximum weight of food in any stomach was 277 gm. (about 10 oz.) from an adult male cormorant captured off Cape Point during September. *A mean weight of* 86·5 *gm.* (*S* 75·9) *was found in* 73 *stomachs collected during* 1954–56.

(*b*) Size of Prey.

The largest prey was a conger-eel 42 cm. long, occupying the whole stomach and guilet of a cormorant collected in Table Bay during October. A sandcord 18 cm. long was folded in another stomach, but other sandcords of 24 cm. length were also found. A single steenvis about 27 cm. long was recorded from one stomach. Clinids up to 28 cm. long were occasionally eaten.

(*c*) Numerical Composition of the Prey.

Fish formed 57 per cent of the diet on a numerical basis (see Table 14); other food was dominated by crustaceans (21 per cent) and cephalopods (15 per cent). Numerically the main prey was in the ratio of—

4 fish: 2 crustaceans: 1 cephalopod; or
61 per cent fish: 23 per cent crustaceans: 16 per cent cephalopods.

(*d*) **Composition by Weight.**

Fish were 78 per cent of all food, crustaceans 12 per cent and cephalopods 9 per cent (see Table 16). Rockfish were 51 per cent of all fish. Octopus and squid were consumed in somewhat similar amounts. Rock lobsters surpassed all other crustaceans.

On the basis of weight, the chief food items were as follows:—

9 fish: 1 crustacean: 1 cephalopod; or
78 per cent fish: 12 per cent crustacean: 9 per cent cephalopod.

(e) **Composition by Frequency of Occurrence.**

Fish were found in 61 (84 per cent) of the stomachs, crustaceans in 36 (49 per cent) and cephalopods in 28 (38 per cent). Clinids and blennies in 38 stomachs were the most important fish. Suckerfish were in seven stomachs (see Table 15). Isopods in 16 stomachs and Cape rock lobsters in 13 stomachs were the chief crustacean prey. Octopuses were at least 35 per cent by frequency of occurrence of the other cephalopods species.

On the basis of frequency, the chief prey occurred roughly in the following ratio:—

2 fish: 1 crustacean: 1 cephalopod; or
49 per cent fish: 28 per cent crustaceans: 23 per cent cephalopods.

(*f*) **Regurgitations.**

Bank cormorants occasionally regurgitated when handled on land. Traces of deliberately regurgitated remains of meals are often scattered among the nests. In November, 1950, twelve such vomits (encased in mucus) were collected from Seal Island (False Bay) and the prey on a frequency basis was: 11 fish, 8 cephalopods, 3 crustaceans, 5 molluscs, 4 stones. Remains of a barnacle and crab (claws) were recorded from the three regurgitations containing crustaceans. Forty cephalopods were counted in the eight regurgitations containing traces of this prey.

(iv) Individual Food Items.

(*a*) **Rockfish.**

One hundred and nine clinids weighing 1,509 gm. were counted in 27 stomachs. They included *Clinus superciliosus, Blenniomimus taurus, Ophthalmolophus venustris, Cirrhibarbis capensis, Pavoclinus heterodon, Gynutoclinus rotundifrons* and several other unidentified species. They were collected in the spring and autumn mostly. Some clinids were spawning in August when captured by the cormorants.

Forty-seven blennies in eleven stomachs weighed 899 gm. They included *Chalaroderma capito, Blennius cristatus* and *B. cornutus*. Other rockfish appearing in single stomachs are listed in the table at (g) below.

(*b*) **Suckerfish** (*Chorisochismus dentex*).

Fourteen suckerfish in seven stomachs from various parts of the Cape Peninsula indicated that they were fairly important items in the diet.

(*c*) **Sandeel** (*Ammodytes capensis*).

Five stomachs contained six sandeels, five of them being caught in Table Bay during January and one near Ysterfontein during November.

(*d*) **Anchovy** (*Engraulis japonicus*).

Juvenile anchovies were taken near Danger Point in October.

(e) **Gurnards.**

Gurnards were preyed upon during February, June and August. Four *Trigla capensis* and three *T. queketti* were taken near Simon's Bay in August. Three *T. africana* were caught off Danger Point in June, and two off Dassen Island in February.

(*f*) **Soles and Flounders.**

Cape soles (*Heteromycteris capensis*) were taken in February, August and December near Dassen Island and in False Bay. Five flounders together with soles were caught near Dassen Island in February and near Robben Island in June.

(*g*) **Miscellaneous Other Fish.**

A variety of other fish appeared in single stomachs as follows (see also Table 14):—

Species.	Month.	Place.
Gilias capensis	October	Danger Point.
Gobius sp.	June	Danger Point.
Pterogymnus laniarius	August	False Bay.
Gymnocrotaphus curvidens	January	Robben Island.
Gaidropsaurus capensis	February	Robben Island.
Pterosmaris axillaris	December	Table Bay.
Syngnathus fasciatus	April	Table Bay.
Batrichthys felinus	September	Cape Point.

(*h*) **Crustaceans.**

Traces of decapod crustaceans appeared in 20 stomachs, *Jasus lalandii* in 13 stomachs being the most common. Pieces of unidentified crab claws and legs occurred in three stomachs. *Hymenosoma*, *Porcellana* and *Pilumnoidea* were found in several other stomachs. Megalopa were recorded only once during May.

Amphipods occurred singly in ten stomachs. They included *Lyianassa*, *Paramoera*, *Nebalia*, *Hyperia*, *Ampelisca* and other unidentified species.

Isopods in 13 stomachs were mostly parasitic forms known to come from one or other of the fish hosts. They included *Cymodoce setulosa*, *Cirolana sulcata*, *C. imposita*, *Livoneca reynaudi*, *Codonophilis*, *Cymothea*, *Janira capensis*, *Rocinela* and *Sphaeramene microtylotus*.

(*i*) **Molluscs.**

Traces of 71 cephalopods were found in 28 stomachs from all parts of the coast of the Cape Peninsula. One bird was shot when actually swallowing an octopus weighing 214 gm. (Sand Bay in May).

Various other molluscs (gasteropods and bivalves) in 13 stomachs included *Gibbula*, *Nassa*, *Tritonalia*, *Tricolia*, *Vermetus*, *Chiton*, *Patella*, *Scala*, *Mytilus* and *Fissurella*.

(*j*) **Echinoderms.**

A small sea-urchin (*Echinus*) was found in a stomach from Cape Point (November).

(*k*) **Miscellaneous Items.**

Feathers and stones were included among other items. A maximum of 10 stones was found in one stomach. Nematodes occurred in almost all stomachs, up to 33 being counted in one specimen. On no occasion did feathers appear to have any special functions as has been reported for other diving birds (Madsen, 1957).

(v) Feeding Habits.

Bank cormorants are solitary fishermen. It rarely happens that more than four or five birds will fish in the same locality. Although they leave their nesting places singly, two or three birds will occasionally travel together to or from the fishing grounds.

They take their food by diving to depths varying from a few feet to a few fathoms, spending between 30 and 50 seconds in dives after prey, and from five to ten seconds on the surface between dives. About ten dives constitute a feeding spell, but this varies with the amount of prey caught. Spells of diving are repeated unless the bird flies back to the nest or to a convenient roost nearby.

From the examination of stomachs collected during 1954–56, most food is taken between 0900 and 1000 SAST, although large quantities were consumed at other times. A low percentage intake was found in stomachs collected after 1400 SAST (see Table 13).

(vi) Consumption of Food.

Eight specimens had food weighing more than 200 gm., i.e. over 50 per cent of the statistical maximum. Three of these specimens were caught in the morning, others during the afternoon. By inspecting the state of digestion of the prey, it was possible to allocate them to various meals. This is done in Table 20, from which it is deduced that at least two-thirds of the stomach is evacuated before feeding is resumed. An average of about 146 gm. (maximum 242 gm.) appears to constitute a meal. In the afternoon some bank cormorants held traces of three meals, but confirmation of the third meal is difficult owing to differential digestion of the prey.

On the basis of two meals daily, cormorants are capable of consuming roughly 292 gm., or about 10 oz. during a day's fishing (maximum 484 gm. or about 1 lb. 1 oz.). Assuming that the bank cormorants each consume about 230 lb. of food per year (by feeding continuously for 365 days), then about 350 short tons of marine organisms are taken by the population (3,000) estimated to resort to the south-western Cape. Fish constitute 78 per cent or 273 tons, crustaceans 12 per cent or 42 tons, and cephalopods 9 per cent or 32 tons. Only a small portion of the fish are of commercial value but at least 90 per cent of the crustaceans, viz. rock lobsters, are of interest to man.

5. The White-breasted Cormorant.

Large White-breasted cormorants (*Phalacrocorax carbo lucidus*) form relatively small populations on the guano islands and small rocks off the south-western coast of the Cape Province. They are not considered of great commercial value. The cormorants were rare in all areas through which patrol-boats searched during 1954–56, and only 11 specimens were actually collected (see Table 21). The White-breasted cormorants were usually encountered near reefs or close inshore but were prone to fly away when the patrol-boats approached too closely.

(i) Bionomics.

The partially white under-surface and brownish-black plumage of the back immediately distinguish the White-breasted cormorants. The belly is black but the neck and chest are white in adults whereas younger birds, of much the same size, have the whole underside a brownish colour. A yellow naked patch in front of the eye in young birds becomes mottled green with age. White feathers appear on the thighs of breeding adults.

This cormorant has a wing span of 54 inches, a length of about 37 inches. Standard dimensions (in mm.) of a few males examined at sea were: length 892 (3), culmen 67 (3), wing 337 (2) and tail 134 (2). The mean weight of three adult males was 109 oz. or 3,053 gm. *The mean weight of all White-breasted cormorants collected at sea was* 103 *oz. or* 2,884 *gm.*

White-breasted cormorants breed in the winter usually from April until September. There is, however, some variation in the start of nesting as eggs have been reported from Knysna in February (Sclater, 1906) and from Malagas Island in December (Bentham, 1929). Roberts (1940) seems to have originated the idea that the coastal cormorants breed in January and October but those inland during June. Mr. E. L. Shewell (*in litt.*) informs me that White-breasted cormorants commence nesting during March at Barberspan (Transvaal), eggs being laid in any month from May until August. On the Cape guano islands, too, nesting commences in the winter, young being completely fledged in the early summer (December), although an occasional clutch may be hatched in early November.

Clutches of 3 to 4 eggs are laid and incubated for 22 to 27 days (Priest, 1948).

There is no information about the duration of feeding journeys except that the cormorants follow the usual pattern of daylight feeding with a return to nests or roosts in the late afternoon. The appearance of regurgitations suggests that there are long periods of inactivity between feeding journeys.

With one exception (November), all specimens showed signs of moulting. Immature cormorants appear to acquire the half-white underside when moulting in autumn, completing the plumage change by September.

(ii) Distribution and Abundance.

The widespread (African) distribution of the White-breasted cormorants has led to the establishment of several races for those inland (on lakes and rivers) and for those at the coast. White (1950), however, contends that all African races of *Phalacrocorax carbo* should be united under *P. carbo lucidus*, but Mackworth-Pread and Grant (1951) retain the identity of the race *lugubris* frequenting inland waters. Some finalisation of this taxonomic confusion is important as it affects any discussion of the distribution and density of particular populations.

According to its present classification, *P. lucidus* extends from the Cape Province up the West coast of Africa as far as the Rio de Oro (Bird, 1937) and across to the Cape Verde Islands (Alexander, 1898). It is mostly a coastal species but is also found far inland over South Africa.

The extent of ranging from colonies on the coast is virtually unknown, but Mr. Shewell (*in litt.*) informs me of ringed birds recovered 320 miles south of their place of banding at Barberspan. Other ring recoveries are listed by Ashton (1957). It is conceivable that the coastal birds leave the entire south-western Cape during the non-breeding season, an exodus which is suggested by the deserted colonies and dearth of birds at sea (in late December, 1948, a flock of 10 White-breasted cormorants passed Sinclair Island flying northward).

White-breasted cormorants of the south-western Cape nest on Dyer, Seal, Dassen Jutten, Marcus and Penguin Islands. Numbers may be seen roosting on Schaapen and Meeuw Islands (Saldanha Bay) but their exact status there is not known. By far the largest colony is at Jutten Island (about 300 nests), the other islands holding small groups seldom exceeding 10 or 20 nests. The total population of adults on the south-western Cape islands is estimated at about 900. This would be augmented by birds nesting on coastal rocks such as Smitswinkel and elsewhere towards Hermanus. For purposes of computation the total population in these waters is taken as 1,000.

(iii) General Account of the Food.

Inland residents feed extensively on frogs (Gurney, 1909) or fish (Bannerman, 1930). Priest (1933) found a mass of shell and debris of crabs, etc., at their roosting places. Koch (1943) recorded a large bass in a White-breasted cormorant shot near Paardevlei (Somerset West). Joubert (1943) watched a White-breasted cormorant catching frogs in the shallow water of Zeekoe Vlei (Cape). Shewell (*in litt.*) believes that they feed extensively on carp at Barberspan. Davies (1955) notes that they hunt for harders (Mugillidae) near sandy beaches. A

similar wide diversity of prey over the geographical range of the predator, is taken by the allied southern cormorant (*P. carbo*) in Europe (Madsen and Sparck, 1950).

During the 1954–56 investigations, White-breasted cormorants were found to have consumed the following prey: Hottentot-fish (*Pachymetopon blochii*), Steenvis (*Chilodactylus fasciatus*), Panga (*Pterogymnus laniarius*), clinids, various crustaceans and molluscs.

(*a*) Weight of Food in the Stomachs.

A maximum weight of 564 gm. of fish was found in the stomach of a young cormorant collected near Cape Point. The mean weight of food in eleven stomachs of White-breasted cormorants collected at sea was 106·3 gm. or about 4 oz.

(*b*) Composition of the Food.

Fish occurred in all stomachs with food (one stomach was empty), crustaceans in six (54 per cent) and molluscs in one stomach. Stones were found in two stomachs (see Table 21). The crustaceans were only indirectly included in the diet, coming originally from the stomachs of the large fish prey.

(iv) Individual Food Items.

Four steenvis (*Chilodactylus fasciatus*) in three stomachs were the dominant prey. All specimens ranged from 24 to 28 cm. long and weighed from 158 gm. to 446 gm. each. They were taken off Cape Point during March, May and September.

A single Hottentot-fish (*Pachymetopon blochii*), 29 cm. long and weighing 458 gm., was found in a stomach from Cape Point (November).

Two pangas (*Pterogymnus laniarius*) weighing 100 gm. were caught off Cape Point in October.

Crustaceans occurred in six stomachs but these had obviously come from the stomachs of the fish prey. They included four isopods (*Codonophilus imbricatus*), one *Sphaeramena*, a hermit crab and 14 megalopa larvae.

Fragments of an unidentified mollusc, eight stones all weighing less than 5 gm. each, and nematodes were miscellaneous other items in the stomachs (see Table 21).

(v) Other Evidence of Diet.

Two adult White-breasted cormorants shot on Seal Island (False Bay) during November, 1950, were both empty. An immature cormorant shot on Sinclair Island during February, 1948, contained traces of a large maasbanker (*Trachurus trachurus*).

Indigestible debris is regurgitated in small mucus-covered "packets"; 12 of these were recovered from under the tower on Seal Island during October, 1950. All these vomits had large fish bones with two otoliths (except one which had five otoliths), two contained stones and one had many fragments of a bivalve in addition to the fish bones. The jaws of a mussel-cracker (*Sparodon*) were found in one vomit; another contained the remains of a large sparid fish, three red crabs (*Plagusia*) and pieces of a bryozoan.

Young White-breasted cormorants at the new harbour of Hermanus freely take miscellaneous fish thrown to them from the quay-side.

(vi) Feeding Habits.

The cormorants were commonly seen fishing near reefs south of Cape Point, about one mile from the land (S.W. Reef and Anvil Rock). They were solitary fishermen, seldom seen in company with others of their kind.

They fish in water up to five fathoms deep, remaining underwater for 23 to 27 seconds during dives and surfacing for three to 10 seconds. One bird spent an hour ashore before resuming its interrupted fishing.

(vii) Consumption of Food.

Data in Table 22 show that White-breasted cormorants commenced feeding at any time of the day. Some had only just started when caught in the afternoon, others had not even taken a fresh meal by 1545 SAST. Among the 11 specimens listed in this table, five had taken prey shortly before capture, the mean weight of which was 270 gm. (range 116 gm. to 458 gm.). From this evidence and indirectly from the inspection of voluntary regurgitations, the cormorants probably have only two meals per day, consuming about 540 gm. with a maximum of 916 gm., i.e. about 1 lb. 3 oz. or a maximum of 2 lb. per diem.

Assuming that the White-breasted cormorants each take 1 lb. 3 oz. of marine food daily, then the population of 1,000 individuals is likely to take about 220 short tons per year (if non-feeding days are considered this amount will be much less). None of these is fish of great commercial value.

6. The Crowned Cormorant.

The inconspicuous Crowned cormorant *Phalacrocorax africanus coronatus* was seldom seen during cruises in 1954–56. Only nine stomachs were procured either in Table Bay or near Robben Island (see Table 23).

Crowned cormorants are not regarded as an important guano-producing species although sizeable colonies are found on some islands (Dyer, Dassen, Malagas, Schaapen).

(i) Bionomics.

This small, unobtrusive cormorant has a typical tuft of feathers on the crown. The plumage is wholly black but the gape is orange and this colour extends below the bill. The iris is red. It may be confused with the young of the Cape cormorant but the different colours of the eyes and gape readily distinguish them.

Mean standard dimensions (mm.) of five specimens caught at sea during 1954–56 were: length 558; wing 217; tail 133 and culmen 30. The weight of five males ranged from 25 to 31 ounces (mean 27 oz or 756 gm.). A female weighed 24 ounces.

Crowned cormorants nest throughout the year on some of the south-western Cape islands; eggs and chicks being recorded on Malagas Island almost every month of the year. It is possible that the birds have two breeding seasons, namely in the autumn and spring, but this has not been verified. The Crowned cormorants disappear from Schaapen and Dyer Islands during the winter.

Clutches vary from two to four eggs but there is no information about incubation and fledging periods.

Immature birds moult in April and September, the replacement of plumage having little effect on their movements.

(ii) Distribution and Abundance.

Considered to extend to Benguela on the west coast and East London on the south coast, the Crowned cormorant has a rather limited range. It is fairly common on the west coast guano islands but has been found on the mainland near False Bay.

There appear to be about 500 breeding adults on the south-west Cape islands.

Recoveries of ringed Crowned cormorants indicate extensive coastwise movements, up to 130 miles from the place of ringing (Ashton, 1957).

(iii) General Account of the Food.

Specimens collected at sea during 1954–56 had consumed fish (almost invariably clinids) with occasional crustaceans. Two of the nine stomachs were empty; the others had a mean weight of 21 gm. of food. Seven stomachs (80 per cent) had clinid remains (*Clinus superciliosus*), one had two windtoys (*Pterosmaris axillaris*). Isopods were found in two stomachs. Broken mollusc shells appeared in two stomachs (see Table 19).

Three immature Crowned cormorants collected at Schaapen Island in July, 1952, had eaten 13 pipefish (*Syngnathus*), 25 soles (*Heteromycteris*), 38 shrimps (*Palaemon pacificus*) and one isopod (*Paridotea ungulata*). The mean weight of food in these stomachs was 29 gm.

(iv) Consumption of Food.

Although the number of specimens is hardly adequate to compute the probable quantities of prey consumed, some deductions may not be out of place here.

A mean weight of 21 gm. or less than an ounce of food was calculated for all stomachs examined (maximum 69 gm.). From Table 24 virtually all weights represented ultimate meals, the mean weight of which would then be 21 gm. Debris from previous meals was inconspicuous. Unlike the other cormorants, the Crowned cormorant appears to evacuate its stomach completely before commencing another meal. There was little evidence of two meals a day but this is accepted as being the daily feeding cycle.

On the basis of two meals daily, the Crowned cormorant would consume about 42 gm. (maximum 164 gm.) or about $1\frac{1}{2}$ oz. daily. A population of about 500 adult Crowned cormorants, feeding continually for 365 days, would consume about 8 tons of marine prey annually.

7. Conclusions.

The investigation showed that cormorants generally eat a great variety of marine organisms many of which are of no immediate interest to man. Food preferences keep three cormorant species wholly outside the field of commercial fisheries but the Cape cormorant preys on small fish of potential value to man. The wide dispersal of this species off the south-western Cape coast makes it unlikely that deleterious feeding habits will develop in particular areas.

8. Acknowledgements.

I am indebted to Dr. K. Barnard and Professor J. L. B. Smith for identifying many often badly-broken specimens; to my colleagues of the Division of Fisheries my thanks are due for criticism of this manuscript.

9. References.

ALEXANDER, B., 1898.—*Expedition to the Cape Verde Islands.* Ibis, p. 100. London.

ANDERSON, C., 1872.—*Birds of Damaraland.* London.

ASHTON, H., 1957.—*Sixth Ringing Report.* Ostrich, XXVIII (2), pp. 98–115. Pretoria.

AVILA, E., 1954.—*Potencia Deyectiva del Guanay.* Bul. Cient. Cia. Adm. Guano 1 (2), pp. 22–50. Lima.

BANNERMAN, D., 1930.—*Birds of Tropical West Africa.* London.

BENTHAM, R. M., 1929.—*Nesting of Birds in Vicinity of Cape Town.* Ibis, p. 95. London.

BIRD, C. G., 1937.—*Some notes from Port Etienne, etc.* Ibis, pp. 721–731. London.

DAVIES, D. H., 1954.—*The S.A. Pilchard: Development, Occurrence and Distribution of Eggs and Larvae,* 1950–51. Div. Fish., Invest. Report No. 15, 28 pp. Pretoria.

DAVIES, D. H., 1955.—*The S.A. Pilchard: Bird Predators,* 1953–54. Div. Fish., Invest. Report No. 18, 32 pp. Pretoria.

DAVIES, D. H., 1956.—*The S.A. Pilchard: Bird Predators.* 1954–55. Div. Fish., Invest. Report No. 23, 40 pp. Pretoria.

GURNEY, G. H., 1909.—*Birds from British East Africa.* Ibis, pp. 484–532. London.

KOCH, H. J., 1943.—*Records of Birds found on and near Paardevlei.* Ostrich, XIV (1), p. 152. Pretoria.

JOUBERT, H. J., 1943.—*Some Notes on Birds.* Ostrich, XIV (1), p. 2. Pretoria.

MACKWORTH-PRAED, C. and C. GRANT., 1951.—*Birds of Eastern and North-eastern Africa.* vol. 1, p. 836. London.

MADSEN, F. J., 1957.—*On the Food-habits of Some Fish-eating Birds in Denmark.* Danish Review of Game Biology 3 (2), pp. 1–18. Oslo.

MADSEN, F. J. and R. SPARCK, 1950.—*On the Feeding-habits of the Southern Cormorant in Denmark.* Danish Review of Game Biology 1 (3), pp. 44–75. Oslo.

PRIEST, C. D., 1933.—*The Birds of Southern Rhodesia.* London.

PRIEST, C. D., 1948.—*Eggs of Birds Breeding in Southern Africa.* London.

PYM, F. A. O., 1909.—*List of the Birds of the Kaffrarian Frontier.* Jour. S.A. Orn. Union, p. 107.

RAND, R. W., 1952.—*Guano Enterprise in South West Africa.* Ostrich XXIII (3), pp. 169–185. Pretoria.

RAND, R. W., 1959.—*Distribution, Abundance and Feeding-habits of the Cape Fur Seal.* Div. Fish., Invest. Report No. 34, pp. 1–75. Pretoria.

RAND, R. W., 1959a.—*Distribution, Abundance and Feeding-habits of the Cape Gannet.* Div. Fish., Invest. Report No. 39, pp. 1–36. Pretoria.

RAND, R. W., 1960.—*Distribution, Abundance and Feeding-habits of the Cape Penguin.* Div. Fish., Invest. Report No. 41, pp. 1–28. Pretoria.

ROBERTS, A., 1940.—*The Birds of South Africa.* Johannesburg.

SCLATER, W. L., 1906.—*The Birds of South Africa.* London.

SIMPSON, G. and A. ROE, 1939.—*Quantitative Zoology. New* York.

WHITE, C. M. N., 1950.—*African Races of P. carbo.* Ostrich, XXI (1), p. 31. Cape Town.

WOODWARD, R. B. and J. D. S. WOODWARD, 1899.—*Natal Birds.* London.

10. Appendix.

TABLE 1.—Age and Sex of Cape Cormorants collected at Sea during 1954–56.

Month.	Age Group.	1954.		1955.		1956.	
		Males.	Females.	Males.	Females.	Males.	Females.
January	Adults	—	—	3	1	3	1
	Immatures	—	—	1	—	1	—
February	Adults	1	—	1	—	1	—
	Immatures	—	—	—	—	—	—
March	Adults	—	—	2	—	2	—
	Immatures	—	—	1	1	4	2
April	Adults	—	—	2	—	2	—
	Immatures	—	—	1	8	3	—
May	Adults	—	—	—	1	—	—
	Immatures	—	—	6	5	1	2
June	Adults	—	1	—	—	—	—
	Immatures	—	—	3	1	3	4
July	Adults	4	—	—	—	2	1
	Immatures	—	—	—	—	1	—
August	Adults	5	3	—	—	7	1
	Immatures	—	—	—	—	—	1
September	Adults	9	1	3	4	2	—
	Immatures	—	—	—	1	1	2
October	Adults	11	7	9	9	8	1
	Immatures	—	—	—	—	1	—
November	Adults	1	5	4	2	8	1
	Immatures	—	—	—	1	—	—
December	Adults	4	1	3	4	—	4
	Immatures	—	—	—	—	—	2

TABLE 2.—Place of Capture of Cape Cormorants collected at Sea during 1954–56.

Month.	Search Zones					
	Walker Bay. (1)	False Bay. (2)	Cape Peninsula. (3)	Dassen Island. (4)	Jacob's Reef. (5)	St. Helena Bay. (6)
January	—	2	2	6	—	—
February	—	1	—	1	1	—
March	—	6	2	4	—	—
April	—	—	9	9	—	—
May	—	—	15	—	—	—
June	—	—	8	4	—	—
July	—	4	3	—	1	—
August	—	3	—	7	—	7
September	2	1	3	17	—	—
October	11	7	5	18	5	—
November	2	2	5	3	6	4
December	4	—	9	3	—	2

TABLE 3.—Weight of Food in 204 Stomachs of Cape Cormorants collected at Sea during 1954–56.

Month.	Number of Stomachs.	Total Weight of Contents.	Mean Weight of Contents.	Maximum Weight of Contents.
January	10	277	27·7	85
February	3	53	17·7	27
March	12	560	46·7	139
April	18	1,157	64·3	145
May	15	693	46·2	137
June	12	375	31·2	140
July	8	380	47·5	131
August	17	445	26·1	138
September	23	1,644	71·5	186
October	46	2,147	46·7	174
November	22	1,977	89·8	251
December	18	882	49·0	309

TABLE 4.—Numbers of Prey in 204 Stomachs of Cape Cormorants collected at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Trachurus	1	11	33	5	66	—	—	—	3	54	141	22
Engraulis	—	—	—	18	—	—	2	—	127	73	23	7
Sardinops	—	—	—	—	—	—	208	3	2	11	80	20
Etrumeus	—	—	—	—	11	—	—	—	—	—	11	40
Scomber	3	—	—	—	1	—	—	—	—	—	18	—
Ammodytes	17	—	10	—	18	124	—	6	50	64	118	50
Gonorhynchus	—	—	—	32	—	—	—	—	3	1	2	—
Pterosmaris	12	—	1	348	—	—	11	—	—	1	—	—
Palunolepis	—	—	—	—	—	—	—	—	—	3	—	—
Gobius	—	—	—	—	—	—	—	3	—	2	—	—
Blennius	—	—	—	—	—	—	—	—	20	—	5	—
Sardinella	—	—	—	—	—	—	—	—	—	—	—	—
Clinids	—	—	—	—	—	—	2	—	8	1	—	30
Liza	—	—	—	—	—	—	—	1	—	—	—	—
Pachymetopon	—	—	—	1	—	—	—	—	3	—	—	—
Hemirhaphis	—	—	—	—	—	—	—	—	—	—	3	—
Macrorhamphis	—	—	—	—	—	—	—	—	1	—	1	—
Chilodactylus	—	—	—	—	—	—	—	—	1	—	—	—
Trigla	—	—	—	—	—	—	—	—	15	—	—	—
Crustaceans	18	—	7	16	20	—	15	9	44	39	4	16

TABLE 5.—Frequency of Occurrence of Prey in 204 Stomachs of Cape Cormorants captured at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Trachurus	1	1	5	3	9	—	—	—	2	13	7	5
Engraulis	—	—	—	2	—	—	1	—	10	12	6	1
Sardinops	—	—	—	2	—	—	3	3	1	5	3	1
Etrumeus	—	—	—	4	2	—	—	—	—	—	2	1
Scomber	1	—	—	—	1	—	—	—	—	—	2	0
Ammodytes	2	—	3	—	2	6	—	2	4	6	6	1
Gonorhynchus	—	—	1	3	—	—	—	—	1	1	2	0
Pterosmaris	1	—	1	5	—	—	2	—	—	1	—	—
Palunolepis	—	—	—	—	—	—	—	—	—	1	—	—
Gobius	—	—	—	—	—	—	—	1	—	1	—	—
Blennius	—	—	—	—	—	—	—	—	1	—	1	—
Sardinella	—	—	—	—	—	—	—	—	—	—	1	—
Clinids	—	—	—	—	—	—	1	—	1	2	—	2
Liza	—	—	—	—	—	—	—	1	—	—	—	—
Pachymetopon	—	—	—	1	—	—	—	—	1	—	—	—
Hemirhamphis	—	—	—	—	—	—	—	—	—	—	1	—
Macrorhamphis	—	—	—	—	—	—	—	—	—	1	—	—
Chilodactylus	—	—	—	—	—	—	—	—	1	—	—	—
Trigla	—	—	—	—	—	—	—	—	1	—	—	—
Unidentified fish	3	2	4	—	4	—	1	6	4	6	7	9
Crustaceans	3	—	4	6	4	—	3	13	10	36	3	4

TABLE 6.—Weight (gm.) of Prey* in 204 Stomachs of Cape Cormorants captured at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Trachurus	10	27	276	41	455	—	—	—	24	472	414	445
Engraulis	—	—	—	50	—	—	16	—	862	391	136	45
Sardinops	—	—	—	129	—	—	208	201	110	394	184	20
Etrumeus	—	—	—	301	38	—	—	—	—	—	43	60
Scomber	20	—	—	—	30	—	—	—	—	—	77	—
Ammodytes	140	—	87	—	107	370	7	47	290	546	749	77
Gonorhynchus	—	—	65	30	—	—	—	—	15	25	8	—
Pterosmaris	20	—	10	528	—	—	94	—	—	5	—	—
Palunolepis	—	—	—	—	—	—	—	—	—	60	—	—
Gobius	—	—	—	—	—	—	—	12	—	2	—	—
Blennius	—	—	—	—	—	—	—	—	70	—	50	—
Sardinella	—	—	—	—	—	—	—	—	—	—	60	—
Clinids	—	—	—	—	—	—	35	—	60	102	—	49
Pachymetopon	—	—	—	50	—	—	—	25	40	—	—	—
Hemirhamphis	—	—	—	—	—	—	—	—	—	—	10	—
Macrorhamphis	—	—	—	—	—	—	—	—	2	—	5	—
Trigla	—	—	—	—	—	—	—	—	15	—	—	—
Unidentified fish	72	26	110	—	55	—	10	145	25	57	103	155

* Applies only to prey weighing over 5 gm.

TABLE 7.—Combinations of Various Prey in 204 Stomachs of Cape Cormorants collected at Sea during 1954–56.

Species.	*Trachurus.*	*Engraulis.*	*Sardinops.*	*Pterosmaris.*	*Gonorhynchus.*	*Ammodytes.*	*Etrumeus.*	*Scomber.*	Clinids.	Unidentified Fish.	Cephalopods.	Crustaceans.	Stones.
Trachurus	(18)	9	5	1	2	3	3	3	1	10	0	9	1
Engraulis	9	(6)	4	1	2	0	1	0	0	4	0	9	1
Sardinops	5	4	(9)	0	1	0	3	0	1	1	0	3	0
Pterosmaris	1	1	0	(2)	1	0	0	0	1	1	0	6	0
Gonorhynchus	2	2	1	1	(0)	0	1	0	1	0	0	6	0
Ammodytes	3	0	0	0	0	(20)	1	0	0	4	0	3	0
Etrumeus	3	1	3	0	1	1	(5)	0	0	0	0	0	0
Scomber	1	0	0	0	0	0	0	(2)	0	1	0	1	0
Clinids	1	0	1	1	1	0	0	0	(0)	3	1	5	0
Unidentified fish	10	4	1	1	0	4	0	1	3	(10)	0	7	8
Cephalopods	0	0	0	0	0	0	0	0	1	0	(0)	1	0
Crustaceans	9	9	3	6	6	3	0	1	5	7	1	(5)	2
Stones	1	1	0	0	0	0	0	0	0	8	0	2	(1)

TABLE 8.—General Combinations of Prey in Stomachs of 204 Cape Cormorants collected at Sea during 1954–56.

Combination of Prey.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Fish only	5	3	7	11	9	6	6	8	11	24	18	10	118
Fish and Cephalopod	—	—	—	—	—	—	—	—	—	1	—	—	1
Fish, Cephalopod and Crustacean	—	—	—	1	—	—	—	—	—	—	—	—	1
Cephalopod only	—	—	—	—	—	—	—	—	—	—	—	—	0
Cephalopod and Crustacean	—	—	—	—	—	—	—	—	—	—	—	—	0
Stones only	—	—	1	—	—	1	—	—	1	3	1	5	12
Fish and Crustacean	1	—	4	5	4	—	1	3	9	15	3	3	48
Empty	1	—	1	1	2	6	—	6	2	5	1	4	29

TABLE 9.—Hourly Weights (gm.) of Food in Stomachs of Cape Cormorants collected at Sea during 1954–56.

Time of Day.	Number of Stomachs.	Total Weight of Food.	Mean Weight of Food.	Hourly Weight as percentage of Total Weight.
0700–0800	6	179	29·8	2·0
0800–0900	12	620	51·7	6·0
0900–1000	35	1,600	45·7	15·0
1000–1100	41	2,288	55·8	22·0
1100–1200	20	784	39·2	7·0
1200–1300	19	708	37·2	7·0
1300–1400	29	1,924	66·4	18·0
1400–1500	13	712	54·9	7·0
1500–1600	17	792	46·6	7·5
1600–1700	2	18	9·0	0·1
1700–1800	7	813	116·1	8·0
1800–1900	1	21	21	0·2

TABLE 10.—Consumption of Food by Cape Cormorants during 1954–56.

Time of Day.	Number of Specimens.	Mean Weight of Stomach Contents.	Mean Weight of Last Meal.	Mean Weight of Penultimate Meal.
0800	4	145·7	145·7	—
0900	8	110·0	102·5	60
1000	10	97·4	96·8	trace.
1100	5	75·0	75·0	—
1200	4	96·7	96·7	—
1300	10	101·8	101·8	—
1400	4	107·2	107·2	—
1500	8	86·8	86·8	—

TABLE 11.—Number and Sex of Bank Cormorants collected at Sea during 1954–56.

Month.	Search Areas.						Total.
	1.	2.	3.	4.	5.	6.	
January	—	—	5 males.	1 male.	—	—	6
February	—	—	1 male.	3 males. 1 female.	—	—	5
March	—	1 male.	—	2 males. 4 females.	—	—	7
April	—	—	3 males. 1 female.	4 males. 2 females.	—	—	10
May	1 male.	—	1 male. 2 females.	1 male. 2 females.	—	—	7
June	2 males.	—	3 males. 1 female.	1 male. 1 female.	—	—	8
August	—	2 males.	1 male. 1 female.	—	—	—	4
September	—	1 female.	3 males.	1 male.	—	—	5
October	1 male. 1 female.	—	—	1 male. 3 females.	—	—	6
November	1 male.	—	3 males. 3 females.	4 males.	—	—	11
December	1 male.	—	3 males.	—	—	—	4

TABLE 12.—Weight of Food* in Stomachs of 73 Bank Cormorants collected at Sea during 1954–56.

Month.	Weight of Food. (gm.)		
	1954.	1955.	1956.
January	—	101 (2)	204 (3)
February	—	66 (1)	313 (2)
March	—	237 (6)	80 (1)
April	—	363 (6)	200 (2)
May	—	437 (4)	577 (3)
June	682 (5)	—	140 (3)
July	—	—	—
August	307 (2)	—	225 (2)
September	523 (2)	57 (2)	34 (1)
October	119 (3)	402 (3)	—
November	101 (1)	518 (5)	325 (3)
December	131 (1)	—	172 (3)

* Stomachs with food are shown in brackets.

TABLE 13.—Hourly Weights of Food in Stomachs of 73 Bank Cormorants collected at Sea during 1954–56.

Time of Day.	Number of Stomachs.	Total Weight of Food. (gm.)	Mean Weight of Food. (gm.)	Hourly Weight as percentage of Total Weight. (gm.)
0700–0800	—	—	—	—
0800–0900	6	707	114·5	11·2
0900–1000	19	1,389	73·1	22·0
1000–1100	13	823	63·3	13·0
1100–1200	7	512	64·0	8·1
1200–1300	6	890	148·4	14·1
1300–1400	8	937	117·1	14·8
1400–1500	1	83	83·0	1·3
1500–1600	2	331	165·0	5·2
1600–1700	3	431	144·0	6·8
1700–1800	—	—	—	—
1800–1900	1	224	224·0	3·5

TABLE 14.—Numbers of Fish in 73 Stomachs of Bank Cormorants collected at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Clinidae	—	—	15	5	18	21	—	12	8	9	10	11
Blennidae	—	—	—	3	19	1	—	—	2	—	22	—
Gilias	—	—	—	—	—	—	—	—	—	4	—	—
Gobius	—	—	—	—	—	4	—	—	—	—	—	—
Triglidae	—	2	—	—	—	3	—	7	—	—	—	—
Chilodactylus	—	—	—	—	2	1	—	—	—	—	—	—
Chorisochismus	—	—	2	—	2	1	—	—	4	—	3	2
Pterogymnus	—	—	—	—	—	—	—	1	—	—	—	—
Gymnocrotophus	1	—	—	—	—	—	—	—	—	—	—	—
Pterosmaris	—	—	—	—	—	—	—	—	—	—	—	1
Ammodytes	5	—	—	—	—	—	—	—	—	—	33	—
Syngnathus	—	—	—	7	—	—	—	—	—	—	—	—
Gonorhynchus	5	—	—	—	—	—	—	—	—	—	1	—
Engraulis	—	—	—	—	—	—	—	—	—	?	—	—
Batrichthys	—	—	—	—	—	—	—	—	1	—	—	—
Gaidropsaurus	—	1	—	—	—	—	—	—	—	—	—	—
Heteromycteris	—	1	—	—	—	—	—	1	—	—	—	8
Bothidae	—	5	—	—	—	1	—	—	—	—	—	—
Conger	—	—	—	—	—	—	—	—	—	1	—	—
Unidentified	2	—	?	—	—	—	—	—	—	—	—	—

TABLE 15.—Frequency of Occurrence of Fish in 73 Stomachs of Bank Cormorants collected at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Clinidae	—	—	4	3	3	4	—	1	4	4	2	2
Blennidae	—	—	—	1	3	1	—	—	2	—	4	—
Gilias	—	—	—	—	—	—	—	—	—	—	1	—
Gobius	—	—	—	—	—	1	—	—	—	—	—	—
Triglidae	—	1	—	—	—	1	—	2	—	—	—	—
Chilodactylus	—	—	—	—	1	1	—	—	—	—	—	—
Chorisochismus	—	—	1	—	1	1	—	—	2	—	1	1
Pterogymnus	—	—	—	—	—	—	—	1	—	—	—	—
Gymnocrotophus	1	—	—	—	—	—	—	—	—	—	—	—
Pterosmaris	—	—	—	—	—	—	—	—	—	—	—	1
Ammodytes	2	—	—	—	—	—	—	—	—	—	3	—
Syngnathus	—	—	—	1	—	—	—	—	—	—	—	—
Gonorhynchus	1	—	—	—	—	—	—	—	—	—	1	—
Engraulis	—	—	—	—	—	—	—	—	—	1	—	—
Batrichthys	—	—	—	—	—	—	—	—	1	—	—	—
Gaidropsaurus	—	1	—	—	—	—	—	—	—	—	—	—
Heteromycteris	—	1	—	—	—	—	—	1	—	—	—	1
Bothidae	—	1	—	—	—	1	—	—	—	—	—	—
Conger	—	—	—	—	—	—	—	—	—	1	—	—
Unidentified	3	—	3	1	—	1	—	—	1	—	—	1

TABLE 16.—Weight (gm.) of Fish in 73 Stomachs of Bank Cormorants collected at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Clinidae	—	—	215	164	290	127	—	60	224	162	260	7
Blennidae	—	—	—	203	235	67	—	—	82	—	312	—
Gilias	—	—	—	—	—	—	—	—	—	30	—	—
Gobius	—	—	—	—	—	7	—	—	—	—	—	—
Triglidae	—	7	—	—	—	68	—	255	—	—	—	—
Chilodactylus	—	—	—	—	70	210	—	—	—	—	—	—
Chorisochismus	—	—	20	—	40	1	—	—	107	—	40	110
Pterogymnus	—	—	—	—	—	—	—	25	—	—	—	—
Gymnocrotophus	75	—	—	—	—	—	—	—	—	—	—	—
Pterosmaris	—	—	—	—	—	—	—	—	—	—	—	40
Ammodytes	45	—	—	—	—	—	—	—	—	—	209	—
Syngnathus	—	—	—	90	—	—	—	—	—	—	—	—
Gonorhynchus	140	—	—	—	—	—	—	—	—	—	40	—
Engraulis	—	—	—	—	—	—	—	—	—	10	—	—
Batrichthys	—	—	—	—	—	—	—	—	29	—	—	—
Gaidropsaurus	—	45	—	—	—	—	—	—	—	—	—	—
Heteromycteris	—	9	—	—	—	—	—	19	—	—	—	100
Bothidae	—	120	—	—	—	36	—	—	—	—	—	—
Conger	—	—	—	—	—	—	—	—	—	135	—	—
Unidentified	15	—	25	5	—	30	—	—	70	—	—	17

TABLE 17.—Numbers of Invertebrates in 73 Stomachs of Bank Cormorants collected at Sea during 1954–56.

Organism.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Crustaceans—												
Crabs	—	2	1	3	2	1	—	?	2	2	—	—
Cape Rock Lobster	—	—	3	3	—	8	—	1	1	7	3	—
Isopods	—	—	4	1	1	3	—	2	25	3	6	2
Amphipods	—	—	1	1	1	7	—	2	—	1	1	—
Copepods	—	—	—	—	—	—	—	—	—	—	1	—
Euphausiids	—	—	—	—	?	—	—	—	—	—	—	—
Cephalopods—												
Octopus	—	—	1	—	1	4	—	5	—	—	3	2
Squid	—	1	—	—	6	2	—	—	—	—	—	—
Cuttlefish	—	1	—	1	—	4	—	—	6	—	8	—
Unidentified	2	—	10	—	1	—	—	—	—	3	9	1
Other Molluscs	—	—	1	—	1	3	—	—	5	4	12	4

TABLE 18.—Frequency of Occurrence of Invertebrates in 73 Stomachs of Bank Cormorants collected at Sea during 1954–56.

Species.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Crustaceans—												
Crabs	—	2	—	1	1	1	—	1	1	2	—	—
Cape Rock Lobster	—	1	1	2	—	2	—	1	1	2	3	—
Isopods	—	—	4	1	1	2	—	1	2	2	1	2
Amphipods	—	—	1	1	1	2	—	2	—	1	1	—
Copepods	—	—	—	—	—	—	—	—	—	—	1	—
Euphausiids	—	—	—	—	1	—	—	—	—	—	—	—
Cephalopods—												
Octopus	—	—	1	—	1	2	—	2	—	2	1	1
Squid	—	1	—	—	2	1	—	—	—	—	—	—
Cuttlefish	—	1	—	1	—	2	—	—	1	—	1	—
Unidentified	2	—	3	—	1	—	—	—	—	—	2	1
Other Molluscs	—	—	1	—	1	2	—	—	2	3	3	2
Echinoderms	—	—	—	—	—	—	—	—	—	—	1	—

TABLE 19.—Combinations of Various Prey in Sromachs of 73 Bank Cormorants collected at Sea during 1954–56.

Combinations of Prey.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Fish only	5	—	2	3	2	—	—	—	1	1	3	2	19
Fish and Cephalopods	1	1	2	1	2	2	—	—	1	1	2	—	13
Fish and Crustaceans	—	1	1	2	1	3	—	2	2	2	3	—	17
Fish, Cephalopods and Crustaceans	—	—	2	1	2	3	—	1	—	1	1	2	13
Cephalopods only	—	—	—	—	—	—	—	—	—	—	—	—	0
Cephalopods and Crustaceans	—	—	—	—	—	—	—	1	—	—	1	—	2
Crustaceans only	—	1	—	1	—	—	—	—	1	1	—	—	4
Empty	—	2	—	2	—	—	—	—	—	—	1	—	5

TABLE 20.—Consumption of Food by Eight Bank Cormorants captured at Sea during 1954–56.

Specimen.	Time of Day.	Total Weight of Food.	Ultimate Meal.	Penultimate Meal.	Ante-penultimate Meal.
4569	0850	235	1 Eel (135 gm.)	1 Clinid (100 gm.)	(Molluscs).
4821	0920	246	1 Squid (214 gm.)	1 Rockfish 1 Squid	—
4414	1015	213	1 Blenny (154 gm.) 1 Blenny (20 gm.)	1 Blenny (10 gm.) 1 Rock lobster (15 gm.)	—
4028	1220	258	1 Steenvis (210 gm.)	2 Squids (40 gm.)	Unidentified fish.
4614	1335	243	3 Suckerfish (40 gm.)	3 Clinids (200 gm.)	(Molluscs).
4210	1400	246	3 Blennies (152 gm.) 1 Suckerfish (90 gm.)	—	—
4202	1610	277	1 Clinid (98 gm.) 1 Frogfish (29 gm.)	1 Suckerfish (17 gm.) 2 Clinids (31 gm.)	3 Cuttlefish (36 gm.). (Molluscs).
4160	1855	224	1 Sole (19 gm.) 1 Panga (25 gm.)	1 Sole (5 gm.) 1 Gurnard (55 gm.)	3 Gurnards.

TABLE 21.—Contents of Stomachs of 11 White-Breasted Cormorants collected at Sea during 1954–56.

Month. Specimen.	Locality.	Time of Day.	Weight of Stomach Contents.	Nature of Food.		
				Fish.	Crustaceans.	Other.
March—						
4721	Cape Point	1245	446	1 *Chilodactylus*	—	—
May—						
4472	Danger Point	1245	16	Unidentified	Unidentified	7 stones.
4475	Cape Point	1345	182	1 *Chilodactylus*	1 *Megalopa*	1 stone.
September—						
4204	Cape Hangklip	0850	11	Unidentified	1 *Isopod*	—
4203	Cape Point	1555	215	2 *Chilodactylus*	—	—
4531	Robben Island	1545	18	Unidentified	Unidentified	—
4970	Table Bay	0925	—	—	—	—
4998	Buffelsbaai	0905	29	Unidentified	Unidentified	—
Oktober—						
5027	Cape Point	1445	116	2 *Pterogymnus*	Unidentified	—
November—						
4601	Cape Point	1125	564	1 *Pachymetopon*	—	—
4615	Cape Point	1355	17	1 Unidentified Clinids.	Unidentified	1 Mollusc.

TABLE 22.—Consumption of Food by 11 White-Breasted Cormorants captured at Sea during 1954–56.

Specimen.	Time of Day.	Total Weight of Food.	Ultimate Meal (all Fish).	Penultimate Meal.
4204	0850	11	?	?
4998	0905	29	1 Sparid (29 gm.)	—
4970	0925	—	—	—
4601	1125	564	1 Hottentot (458 gm.)	Unidentified fish (106 gm.).
4721	1245	446	1 Steenvis (446 gm.)	—
4472	1245	16	?	?
4475	1345	182	1 Steenvis (158 gm.)	?
4615	1355	17	—	?
5027	1445	116	2 Pangas (116 gm.)	—
4531	1545	18	—	?
4203	1550	215	2 Steenvis (174 gm.)	—

TABLE 23.—Contents of Stomachs of Nine Crown Cormorants collected at Sea during 1954–56.

Month and Specimen.	Locality.	Time of Day.	Weight of Stomach Contents. (gm.)	Nature of Contents.
February—				
4716.....	Robben Island.....	1555	15	2 Windtoys; 2 Clinids; 1 Isopod.
4703.....	Robben Island.....	0950	27	1 Clinid; Crustaceans; Mollusc shells.
4373.....	Robben Island.....	1125	—	—
4372.....	Table Bay.....	1120	18	1 Clinid.
4371.....	Robben Island.....	1120	22	1 Clinid.
April—				
4409.....	Robben Island.....	1015	8	Clinid traces.
4784.....	Robben Island.....	0915	—	—
September—				
4978.....	Table Bay.....	1125	11	2 Clinids.
November—				
4608.....	Robben Island.....	1020	62	2 Clinids; Mollusc shells.

TABLE 24.—Consumption of Food by 12 Crown Cormorants collected from Various Localities during 1952–56.

Speciman.	Time of Day.	Total Weight of Food.	Ultimate Meal.	Penultimate Meal.
4784.....	0915	—	—	—
4703.....	0950	27	1 Clinid	—
4409.....	1015	8	(Fish bones)	—
4608.....	1020	62	2 Clinids	(Shells).
4371.....	1120	22	1 Clinid	(Fish bones).
4372.....	1120	18	1 Clinid	—
4373.....	1125	—	(Fish bones)	—
4978.....	1125	11	2 Clinids	—
4716.....	1555	15	2 Windtoys	2 Clinids.
3820.....	p.m.	39	23 Shrimps	—
			5 Pipefish	—
			1 Suckerfish	—
3821.....	p.m.	37	7 Shrimps	—
			8 Pipefish	
			25 Soles	
3822.....	p.m.	10	8 Shrimps	—

TABLE 25.—Consumption of Food by Various Cormorants (*Phalacrocorax*) Frequenting the South-western Cape Coast during 1954–56.

Species.	Mean Body-weight. (gm.)	Statistical Maximum Capacity. (gm.)	Mean Weight of Food in Stomach. (gm.)	Maximum Size of Meal. (gm.)	Mean Size of Meal (gm.)	Meal as Percentage of Body-weight. %	Daily Estimated Consump-tion. (gm.)
carbo.....	2,884	?	106·3	458	270	9–16	540
neglecta.....	1,867	455	86·5	242	146	8–13	292
capensis.....	1,204	322	51·6	309	104	8–25	208
africanus (*coronatus*)..	756	?	21·0	62	21	3–8	42

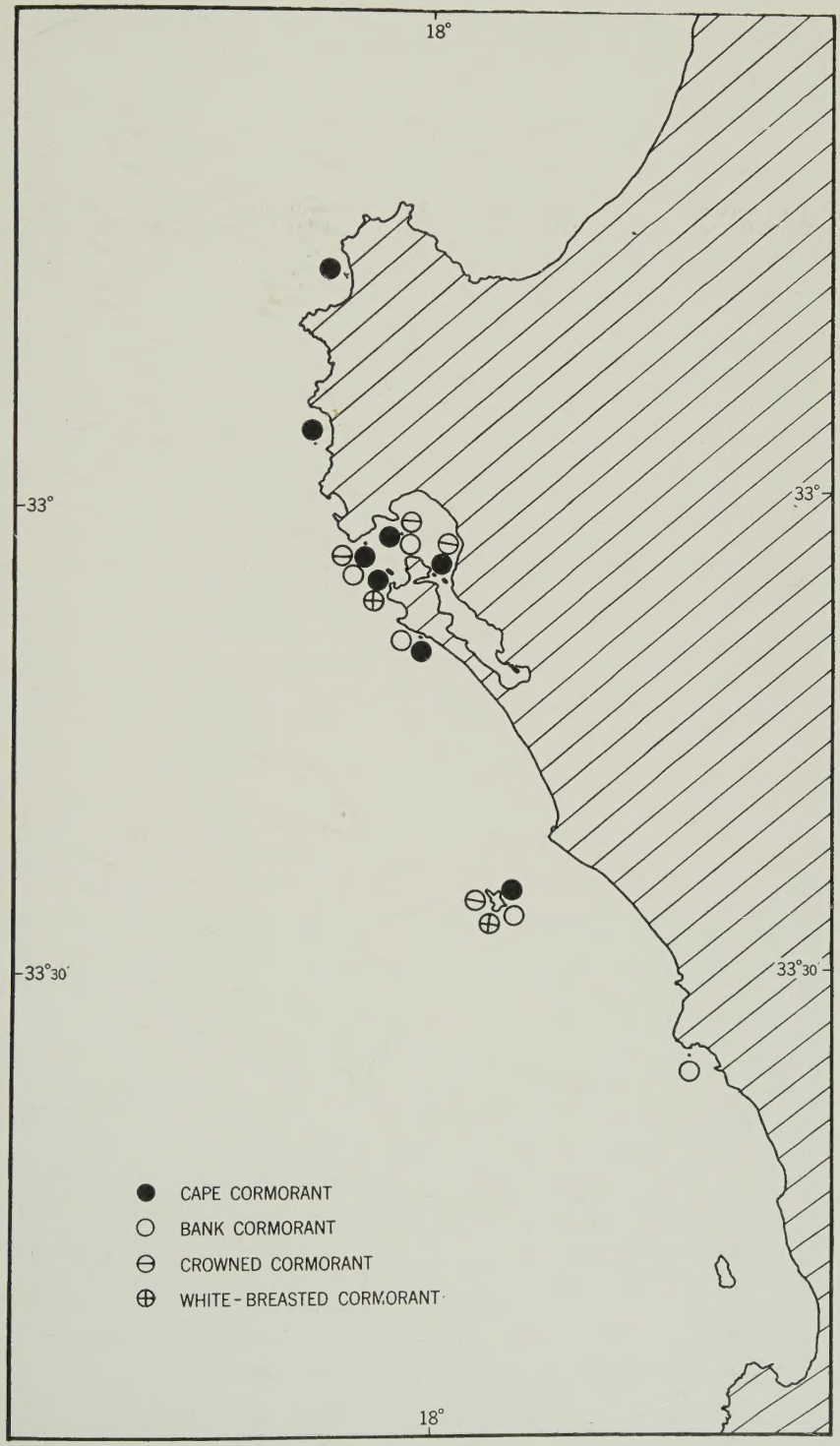

PLATE I. BREEDING COLONIES OF VARIOUS CORMORANTS OFF WESTERN CAPE COAST.

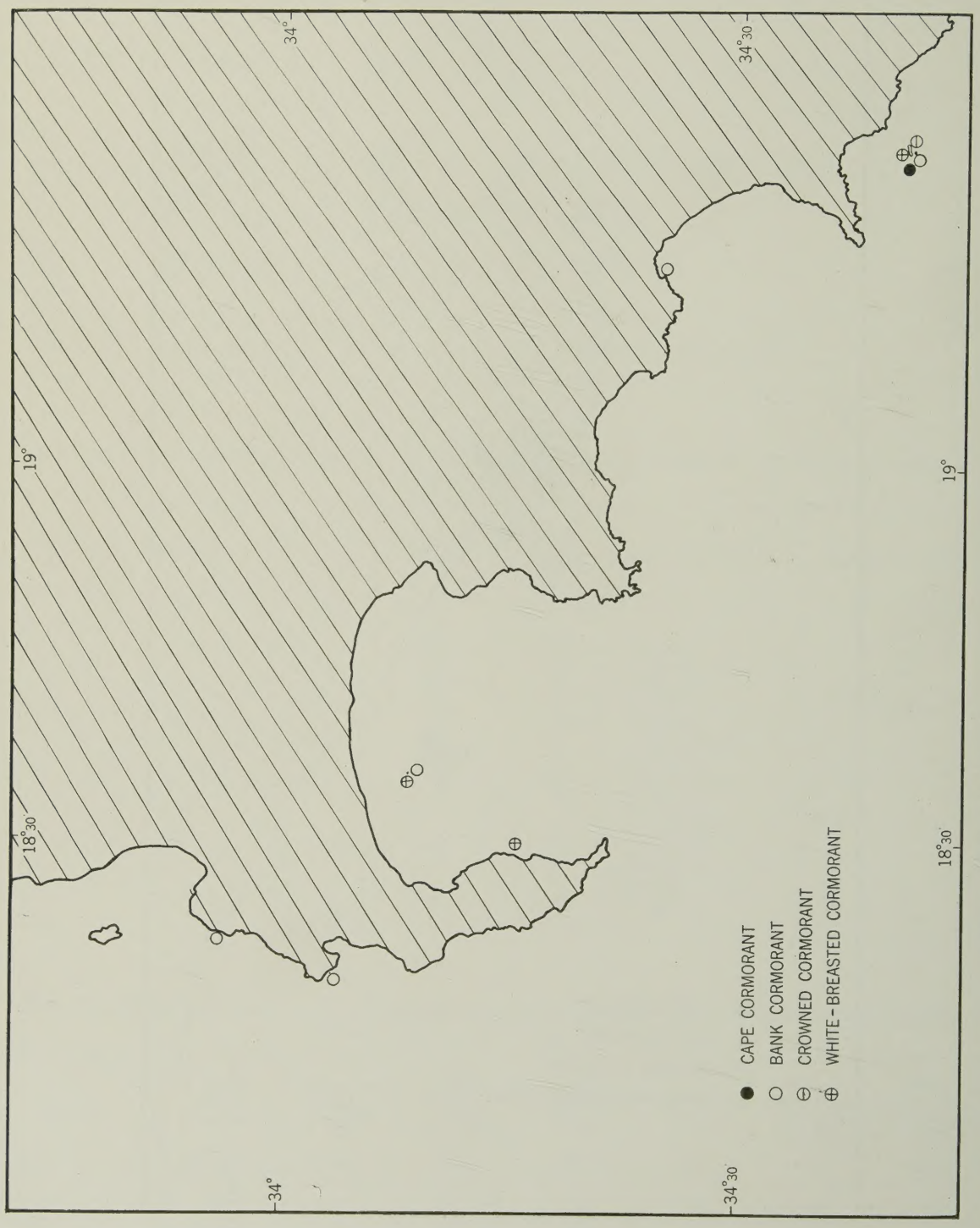

PLATE II. BREEDING COLONIES OF VARIOUS CORMORANTS OFF SOUTHERN CAPE COAST.